

CLAIMS

1. A resource allocation method in a communications system (1) having resources, said method comprising the steps of:
 - dividing said resources into multiple different resource classes based on an associated characteristic allocation time, for each resource class:
 - determining a resource utilization measure; and
 - selecting whether or not to trigger resource allocation based on said resource utilization measure.
2. The method according to claim 1, wherein said determining step and said selecting step are first performed for a resource class having a given characteristic allocation time and are then performed for another resource class having a relatively shorter characteristic allocation time.
3. The method according to claim 1, wherein said selecting step comprises the steps of:
 - comparing said resource utilization measure with a threshold (T_k) associated with said resource class; and
 - triggering resource allocation if said resource utilization measure exceeds said threshold (T_k).
4. The method according to claim 3, wherein a first threshold (T_{FAST}) associated with a first resource class having a first characteristic allocation time is larger than a corresponding second threshold (T_{SLOW}) associated with a second resource class having a second characteristic allocation time, said first allocation time being relatively shorter than said second allocation time.
5. The method according to claim 4, wherein said communications system (1) provides a guaranteed minimum amount of resources of said first class to a connected user equipment (400; 410), and a resource utilization measure of said first resource class exceeds said first threshold (T_{FAST}) and a resource

utilization measure of said second resource class exceeds said second threshold (T_{slow}), said method comprising the steps of:

- triggering resource allocation for said second resource class; and
- temporarily allocating a first resource amount of said first resource class to said user equipment (400; 410) during progression of said resource allocation for said second resource class, said first resource amount being relatively smaller than said guaranteed minimum resource amount, whereby a total resource utilization is temporarily reduced during said progression of said resource allocation for said second resource class.

6. The method according to claim 5, further comprising the step of reallocating a second resource amount of said first resource class to said user equipment (400; 410) after completion of said resource allocation for said second resource class, said second resource amount being equal to or larger said guaranteed minimum resource amount.

7. The method according to claim 3, wherein said dividing step comprises the step of dividing said resources into a first resource class and a second resource class, said method comprising the step of calculating said threshold (T_{slow}) associated with said second resource class based on said threshold (T_{fast}) associated with said first resource class.

8. The method according to claim 1, wherein said resources are radio resources and said method comprising the step of providing said radio resources to user equipment (400; 410) connected to said communications system (1) for enabling utilization of communications services (402; 412, 414) available for said user equipment (400; 410).

9. The method according to claim 1, wherein said characteristic allocation time is a total time required for allocating or reallocating a resource of said resource class.

10. The method according to claim 1, wherein said dividing step comprises the step of dividing said resources into a first resource class and a second resource class, where a resource of said first resource class is allocable with an allocation procedure of a first allocation procedure set and a resource of said second resource class is allocable with an allocation procedure of a second allocation procedure set, said first allocation procedure set comprises at least one of:

- restricting available transport format combinations (TFC) for user equipment (400; 410) connected to said system (1); and
- performing an Adaptive Multi Rate (AMR) mode switch for said user equipment (400; 410),

and said second allocation procedure set comprises least one of:

- performing a channel switch from a dedicated high bit-rate channel to a dedicated low bit-rate channel for said user equipment (400; 410);
- performing a channel switch from a dedicated channel to a common channel for said user equipment (400; 410);
- performing a handover from a first radio access network to a second radio access network for said user equipment (400; 410);
- performing a handover from a first carrier frequency to a second carrier frequency for said user equipment (400; 410); and
- dropping an ongoing call for said user equipment (400; 410).

11. The method according to claim 1, wherein said determining step is performed periodically.

12. The method according to claim 1, wherein said determining step is performed upon a triggering event selected from at least one of:

- a change in the number of available channels for connected user equipment (400; 410);
- a change in the number of connected user equipment (400; 410);
- a change in the number of provided services (402; 412, 414) per user equipment (400; 410);

- a change in QoS requirements of an on-going communications service (402; 412, 414) for connected user equipment (400; 410);
- a reception of an updated mobility measurement report;
- a reception of an updated interference measurement report; and
- a change in data traffic.

13. The method according to claim 1, further comprising the step of selecting any resource to be allocated based on information of QoS requirements for connected user equipment (400; 410).

14. The method according to claim 1, further comprising the step of selecting any resource to be allocated based on resource saving estimation information.

15. The method according to claim 1, wherein said determining step comprises the step of estimating a total power of communications links used for said resource class.

16. A resource allocation system (100) provided in a communications system (1) having resources, said resources being divided into multiple different resource classes based on an associated characteristic allocation time, said resource allocation system (100) comprising means for performing, for each resource class:

- determination (120) of a resource utilization measure; and
- selectively triggering (130) of resource allocation, in dependence of said resource utilization measure.

17. The system according to claim 16, wherein said means (120, 130) is configured for first performing said measure determination and said selectively allocation triggering for a resource class having a given characteristic allocation time and then performing said measure determination and selectively allocation triggering for another resource class having a relatively shorter characteristic allocation time.

18. The system according to claim 16, wherein said selectively allocation triggering means (130) comprises:

- means for comparing (132) said resource utilization measure with a threshold (T_k) associated with said resource class; and
- means for triggering (130) said resource allocation if said resource utilization measure exceeds said threshold (T_k).

19. The system according to claim 18, wherein a first threshold (T_{FAST}) associated with a first resource class having a first characteristic allocation time is larger than a corresponding second threshold (T_{SLOW}) associated with a second resource class having a second characteristic allocation time, said first allocation time being relatively shorter than said second allocation time.

20. The system according to claim 19, wherein said communications system (1) provides a guaranteed minimum amount of resources of said first class to a connected user equipment (400; 410), and a resource utilization measure of said first resource class exceeds said first threshold (T_{FAST}) and a resource utilization measure of said second resource class exceeds said second threshold (T_{SLOW}), said means (130) is configured for:

- triggering of resource allocation for said second resource class; and
- temporarily allocation of a first resource amount of said first resource class to said user equipment (400; 410) during progression of said resource allocation for said second resource class, said first resource amount being relatively smaller than said guaranteed minimum resource amount.

21. The system according to claim 20, further comprising means (130) for reallocating a second resource amount of said first resource class to said user equipment (400; 410) after completion of said resource allocation for said second resource class, said second resource amount being equal to or larger said guaranteed minimum resource amount.

22. The system according to claim 18, further comprising:
- means for dividing (200) said resources into a first resource class and a second resource class; and
 - means for calculating (170) said threshold (T_{SLOW}) associated with said second resource class based on said threshold (T_{FAST}) associated with said first resource class.
23. The system according to claim 16, wherein said characteristic allocation time is a total time required for allocation means (130) to allocate or reallocate a resource of said resource class.
24. The system according to claim 16, wherein said determination means (120) is configured for determining said resource utilization measure periodically.
25. The system according to claim 16, wherein said determination means (120) is configured for determining said resource utilization measure in response to triggering input information.
26. The system according to claim 16, comprising means (140) for selection of any resource to be allocated based on information of QoS requirements for connected user equipment.
27. The system according to claim 16, comprising means (140) for selection of any resource to be allocated based on resource saving estimation information.
28. The system according to claim 16, wherein said determination means (120) is configured for estimating a total power of communications links used for said resource class.
29. The system according to claim 16, wherein said resource allocation system (100) is provided in a network node of said communications system (1).

30. Communications system (1) having resources, said system (1) comprising:

- means for dividing (200) said resources into multiple different resource classes based on an associated characteristic allocation time; and
- resource allocation means (100) for performing, for each resource class:
 - determination of a resource utilization measure; and
 - selectively triggering of resource allocation, in dependence of said resource utilization measure.

31. The system according to claim 30, wherein said resource allocation means (100) is configured for first performing said measure determination and said selectively allocation triggering for a resource class having a given characteristic allocation time and are then performing said measure determination and selectively allocation triggering for another resource class having a relatively shorter characteristic allocation time.

32. The system according to claim 30, wherein said selectively allocation triggering means (100) comprises:

- means for comparing (132) said resource utilization measure with a threshold (T_k) associated with said resource class; and
- means for triggering (130) said resource allocation if said resource utilization measure exceeds said threshold (T_k).

33. The system according to claim 32, wherein a threshold (T_{FAST}) associated with a first resource class having a first characteristic allocation time is larger than a corresponding threshold (T_{SLOW}) associated with a second resource class having a second characteristic allocation time, said first allocation time being relatively shorter than said second allocation time.

34. The system according to claim 32, wherein said resource dividing means (200) is configured for dividing said resources into a first resource class and a second resource class, said system (1) comprising means for calculating (170)

said threshold (T_{SLOW}) associated with said second resource class based on said threshold (T_{FAST}) associated with said first resource class.

35. The system according to claim 30, wherein said characteristic allocation time is a total time required for said resource allocation means (100) to allocate or reallocate a resource of said resource class.

36. The system according to claim 30, wherein said determination means (120) is configured for estimating a total power of communications links used for said resource class.

37. The system according to claim 30, wherein said resources are radio resources and said communication system (1) comprises means for providing said radio resources to user equipment (400; 410) connected to said system (1) for enabling utilization of communications services (402; 412, 414) available for said user equipment (400; 410).

38. A resource allocation method in a communications system (1), said method comprising the steps of:

- providing a guaranteed minimum amount of resources of a first resource class and resources of a second resource class, a characteristic allocation time of said first resource class being relatively shorter than a corresponding characteristic allocation time of said second resource class;
- triggering resource allocation for said second resource class; and
- temporarily allocating a first resource amount of said first resource class during progression of said resource allocation for said second resource class, said first resource amount being relatively smaller than said guaranteed minimum resource amount,

whereby a total resource utilization is temporarily reduced during said progression of said resource allocation for said second resource class.

39. The method according to claim 38, further comprising the step of reallocating a second resource amount of said first resource class after

completion of said resource allocation for said second resource class, said second resource amount being equal to or larger said guaranteed minimum resource amount.

40. The method according to claim 38, wherein said temporarily allocating step comprises the steps of:

- calculating, for said first resource class, a first resource utilization measure;
- comparing said first resource utilization measure with a first threshold (T_{FAST}) associated with said first resource class; and
- triggering said temporary resource allocation if said first resource utilization measure exceeds said first threshold (T_{FAST}).

41. The method according to claim 38, wherein said triggering step comprises the steps of:

- calculating, for said second resource class, a second resource utilization measure;
- comparing said second resource utilization measure with a second threshold (T_{SLOW}) associated with said second resource class; and
- triggering resource allocation for said second resource class if said resource utilization measure exceeds said second threshold (T_{SLOW}).

42. The method according to claim 39, wherein said reallocation step comprises the steps of:

- calculating, for said first resource class, a first resource utilization measure in response to ending said resource allocation for said second class;
- comparing said first resource utilization measure with a third threshold ($h \cdot T_{FAST}$) associated with said first resource class; and
- triggering said reallocation of said second resource amount if said first resource utilization measure is below said third threshold ($h \cdot T_{FAST}$).

43. The method according to claim 38, further comprising the steps of:

- determining a total packet delay (D_{TOTAL}) for user equipment (400; 410) connected to said communications system (1) and utilizing resources of said first resource class;
- comparing said total packet delay (D_{TOTAL}) with a delay threshold (T); and
- reallocating a second amount of said first resource class if said total delay (D_{TOTAL}) exceeds said delay threshold (T), said second amount being equal to or larger than said guaranteed minimum resource amount.

44. The method according to claim 38, further comprising the steps of:

- determining a total packet delay (D_{TOTAL}) for user equipment (400; 410) connected to said communications system (1) and utilizing resources of said first resource class;
- comparing said total packet delay (D_{TOTAL}) with a first delay threshold (T);
- comparing a packet delay (D_{TFC}) introduced by said temporarily resource allocation with a second delay threshold (kT) if said total delay (D_{TOTAL}) exceeds said first delay threshold (T); and
- reallocating a second resource amount of said first resource class if said delay (D_{TFC}) introduced by said temporarily resource allocation exceeds said second delay threshold (kT), said second resource amount being equal to or larger than said guaranteed minimum resource amount.

45. The method according to claim 38, wherein said communications system (1) provides streaming services (402; 412, 414) by means of at least one resource of said guaranteed minimum amount of resources and/or said resources of said second resource class to user equipment (400; 410) connected to said system (1).

46. The method according to claim 39, wherein said temporarily resource allocating step comprises the step of temporarily reducing allowed bit-rate below a guaranteed minimum bit-rate by restricting allowed Transport Format

Combinations (TFC) and said reallocating step comprises the step of increasing said allowed bit-rate to at least said guaranteed minimum bit-rate by releasing said imposed TFC restrictions.

47. A resource allocation system (100) in a communications system (1) providing a guaranteed minimum amount of resources of a first resource class and resources of a second resource class, a characteristic allocation time of said first resource class being relatively shorter than a corresponding characteristic allocation time of said second resource class, said resource allocation system (100) comprising:

- means for triggering (100) resource allocation for said second resource class; and
 - means for temporarily allocating (100) a first resource amount of said first resource class during progression of said resource allocation for said second resource class, said first resource amount being relatively smaller than said guaranteed minimum resource amount,
- whereby a total resource utilization is temporarily reduced during said progression of said resource allocation for said second resource class.

48. The system according to claim 47, further comprising means (100) for reallocating a second resource amount of said first resource class after completion of said resource allocation for said second resource class, said second resource amount being equal to or larger said guaranteed minimum resource amount.

49. The system according to claim 47, wherein said temporarily allocating means (100) comprises:

- means for calculating (120), for said first resource class, a first resource utilization measure;
- means for comparing (132) said first resource utilization measure with a first threshold (T_{FAST}) associated with said first resource class; and
- means for triggering (130) said temporary resource allocation if said first resource utilization measure exceeds said first threshold (T_{FAST}).

50. The system according to claim 47, wherein said triggering means (100) comprises:

- means for calculating (120), for said second resource class, a second resource utilization measure;
- means comparing (132) said second resource utilization measure with a second threshold (T_{slow}) associated with said second resource class; and
- means for triggering (130) resource allocation for said second resource class if said resource utilization measure exceeds said second threshold (T_{slow}).

51. The system according to claim 48, wherein said reallocation means (100) comprises:

- means for calculating (120), for said first resource class, a first resource utilization measure in response to ending said resource allocation for said second class;
- means for comparing (132) said first resource utilization measure with a third threshold ($h \cdot T_{\text{fast}}$) associated with said first resource class; and
- means for triggering (130) said reallocation of said second resource amount if said first resource utilization measure is below said third threshold ($h \cdot T_{\text{fast}}$).

52. The system according to claim 47, further comprising:

- means for determining (150) a total packet delay (D_{total}) for user equipment (400; 410) connected to said communications system (1) and utilizing resources of said first resource class;
- means for comparing (132) said total packet delay (D_{total}) with a delay threshold (T); and
- means for reallocating (130) a second resource amount of said first resource class if said total delay (D_{total}) exceeds said delay threshold (T), said second resource amount being equal to or larger than said guaranteed minimum resource amount.

53. The method according to claim 47, further comprising:

- means for determining (150) a total packet delay (D_{TOTAL}) for user equipment (400; 410) connected to said communications system (1) and utilizing resources of said first resource class;
- means for comparing (132) said total packet delay (D_{TOTAL}) with a first delay threshold (T);
- means for comparing (132) a packet delay (D_{TFC}) introduced by said temporarily resource allocation with a second delay threshold (kT) if said total delay (D_{TOTAL}) exceeds said first delay threshold (T); and
- means for reallocating (130) a second resource amount of said first resource class if said delay (D_{TFC}) introduced by said temporarily resource allocation exceeds said second delay threshold (kT), said second resource amount being equal to or larger than said guaranteed minimum resource amount.

54. The system according to claim 47, wherein said communications system (1) is adapted for providing streaming services (402; 412, 414) by means of at least one resource of said guaranteed minimum amount of resources and/or said resources of said second resource class to user equipment (400; 410) connected to said system (1).

55. The system according to claim 48, wherein said temporarily resource allocating means (100) is configured for temporarily reducing allowed bit-rate below a guaranteed minimum bit-rate by restricting allowed Transport Format Combinations (TFC) and said reallocating means (100) is configured for increasing said allowed bit-rate to at least said guaranteed minimum bit-rate by releasing said imposed TFC restrictions.
